

REMARKS/ARGUMENTS

Claims 1-3, 5-12, 14, 15, 17-22, 24-27, 44 and 61-77 are pending in this application. Claims 65, 66, 72 and 73 have been rewritten in independent form to include all limitations of base claims 61 and 68, respectively, as suggested by the last Office Action, and are now in condition of allowance. Claims 61, 65, 66, 68, 72 and 73 have been also amended to clarify that the “flow of said upper portion of said processing fluid” permits the break of the eddy currents and of the surface tension forces at the air/liquid interface. Applicant gratefully acknowledges the allowance of claims 13, 23, 52 and 58.

Claims 1-3, 5-9, 14, 17-20, 24, 26, 44, 61, 68 and 75- 77 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Nishizawa et al. (U.S. Patent No. 5,275,184) (“Nishizawa”). The rejection is respectfully traversed.

The claimed invention relates to a method for reducing surface contaminants from the air/liquid interface in a wet etching bath. As such, independent claim 1 recites “a method for removing surface contaminants from an air/liquid interface” by “rapidly removing an upper portion of the semiconductor processing fluid” present in a processing bath “to remove said surface contaminants from said air/liquid interface.” Similarly, independent claim 7 recites a method for “reducing the contamination on a semiconductor wafer” by “rapidly removing an upper portion of said etching fluid from said wet etching bath to remove surface contaminants from an air/liquid interface of said wet etching bath.” Independent claim 17 also recites a method for etching a semiconductor wafer with an etching fluid, a portion of which being “rapidly removed . . . from the upper surface of said wet etching vessel.”

Independent amended claims 61 and 68 further recite a “method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath” by

“rapidly removing an upper portion of a semiconductor processing fluid present in said bath to permit flow of said upper portion of said processing fluid and thereby break eddy currents holding said surface contaminants at said air/liquid interface” (claim 61) or “break surface tension forces holding said surface contaminants at said air/liquid interface” (claim 68). Independent claim 75 also recites a “method for reducing the contamination on a semiconductor wafer” by “breaking eddy currents of said wet etching bath by rapidly removing an upper portion of said etching fluid from said wet etching bath, said act of breaking said eddy currents further releasing surface contaminants which are formed at an air/liquid interface of said wet etching bath and held at said air/liquid interface by said eddy currents,” while independent claim 76 recites “breaking surface tension forces of said wet etching bath by rapidly removing an upper portion of said etching fluid from said wet etching bath, said act of breaking said surface tension forces further releasing surface contaminants which are formed at an air/liquid interface of said wet etching bath and held at said air/liquid interface by said eddy currents.” Independent claim 77 further recites a “method for reducing the contamination on a semiconductor wafer” by “processing said semiconductor wafer in a static etching bath containing an etching fluid; and rapidly removing an upper portion of said etching fluid while said semiconductor wafer is in said static etching bath.”

Nishizawa does not disclose the limitations of the claimed invention. Nishizawa discloses an “apparatus for treating a wafer surface” (Col. 3, line 30) and “a system capable of rapidly substituting treatment solutions” (Col. 3, lines 19-20), but not a method for “rapidly removing an upper portion” of the etching fluid containing “surface contaminants,” as independent claims 1 and 7 recite. Nishizawa is also silent about a method for etching a semiconductor wafer by “rapidly removing a portion of said etching fluid from the upper surface of said wet etching vessel,” as independent claim 17 recites. Nishizawa further fails to disclose the step of “breaking surface tension forces of said wet etching bath by rapidly removing an upper portion of said etching fluid from said wet

etching bath, said act of breaking said surface tension forces further releasing surface contaminants which are formed at an air/liquid interface of said wet etching bath and held at said air/liquid interface by said eddy currents,” as independent claim 76 recites, or the step of “breaking eddy currents of said wet etching bath by rapidly removing an upper portion of said etching fluid from said wet etching bath, said act of breaking said eddy currents further releasing surface contaminants which are formed at an air/liquid interface of said wet etching bath and held at said air/liquid interface by said eddy currents,” as independent claim 75 recites. In Nishizawa, the “old treatment solution inside the container is rapidly displaced by the new treatment solution” (col. 3, lines 54-55) so that the wafers do not “experience contact with air during replacement of the treatment solutions.” (Abstract).

Nishizawa simply fails to address “surface contaminants” or “contaminants from an air/liquid interface.” Applicant reemphasizes that, as well-known in the semiconductor art, surface contaminants at the air/liquid interface of a solution are either hydrophobic contaminants, which do not suspend in the solution, or contaminants so light that they float on top of the bath and are trapped in surface tension. Surface contaminants are not contaminants suspended in a solution but rather contaminants trapped at the surface. Eddy currents, also called surface currents, and liquid /air surface tension forces trap the surface contaminants at the surface of the bath, making the removal of such surface contaminants difficult. (Application at 3, lines 7-10). This is why a sudden, physical force is necessary for the removal of the surface contaminants. Simply overflowing a solution, as in Nishizawa, will not suffice to break established eddy currents and/or tension forces and the subsequent removal of surface contaminants.

Moreover, Applicant respectfully submits that Nishizawa addresses hydrophilic contaminants or contaminants suspended in a cleaning bath, and not “surface contaminants from an air/liquid interface” in such cleaning bath, as in the claimed invention. Nishizawa simply displaces the cleaning solution with a rinsing solution, for example water, and, therefore, Nishizawa is silent about any “surface contaminants at an air/liquid interface,”

or about the removal of such surface contaminants which do not suspend in a solution, much less about “rapidly removing” the upper portion of an upper portion of such solution, as independent claims 1, 7, 17, 44, 75-77 and independent amended claims 61 and 68 recite. Accordingly, the present invention is not anticipated by Nishizawa and withdrawal of the rejection of claims 1-3, 5-9, 14, 17-20, 24, 26, 44, 61, 68 and 75-77 is respectfully requested.

Claims 10, 27, 62 and 69 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishizawa et al. (U.S. Patent No. 5,275,184) (“Nishizawa”) in view of Itoh et al. (U.S. Patent No. 5,795,401) (“Itoh”). The rejection is respectfully traversed.

The claimed invention would not have been obvious over Nishizawa in view of Itoh. To establish a *prima facie* case of obviousness, three requirements must be met: (1) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to modify the reference or combine reference teachings; (2) a reasonable expectation of success; and (3) the prior art reference (or references when combined) must teach or suggest all the claim limitations. More importantly, the teaching or suggestion to make the claimed combination and the reasonable expectation for success must both be found in the prior art and not based on Applicant’s disclosure. See, e.g., In re Royka, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974).

First, not all limitations of claims 10, 27, 62 and 69 are taught or suggested by the prior art, alone or in combination. Nishizawa is silent about the rapid removal of “surface contaminants” or of “surface contaminants from an air/liquid interface” by opening a valve, hingedly releasing a door, sliding a door, or telescopically collapsing sidewalls of a vessel containing an etching bath. Even if Itoh describes the use of a paddle to allow a back pressure fluid to be discharged through a slit-shaped fluid jet outlet located in the center of such paddle, Itoh does not discuss the removal of any contaminants from the etching bath, much less to the removal of “surface contaminants from an air/liquid interface.” Itoh merely refers to the scrubbing of a wafer surface using a rotary brush while pressure is applied by jetting a fluid on the other surface of the wafer. In addition, Itoh



does not teach or suggest rapidly removing a substantial portion of the etching liquid. Itoh does not even mention an etching fluid. Itoh refers only to a wash liquid that is purified water and that comes into contact with a rotary brush that cleans the wafer surface. Thus, there is no teaching or suggestion in either of these two references for the claimed subject matter.

Second, the references are also not properly combinable in view of the diverse art areas and the lack of suggestion or motivation to combine the references. Courts have generally held that, to establish a *prima facie* case of obviousness, “[I]t is insufficient that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor.” Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934, 15 U.S.P.Q.2d 1321, 1323 (Fed. Cir. 1990). This way, “the inquiry is not whether each element existed in the prior art, but whether the prior art made obvious the invention as a whole for which patentability is claimed.” Hartness Int’l, Inc. v. Simplimatic Engineering Co., 819 F.2d 1100, 1108, 2 U.S.P.Q.2d 1826, 1832 (Fed. Cir. 1987). Accordingly, a determination of obviousness “must involve more than indiscriminately combining prior art; a motivation or suggestion to combine must exist.” Pro-Mold & Tool Co., 75 F.3d at 1573.

In the present case, Nishizawa refers to wafer surface treatment by using at least two different solutions. Itoh, on the other hand, refers to the actual physical cleaning and scrubbing of the wafer surface by mechanical means such as a cylindrical rotary brush. The references are not even directed to the same problem; each addresses a totally different problem. It is clear, therefore, that the rejection is based on picking and choosing selected portions of each reference, without regard to the totality of teachings of the references, in an attempt to improperly use hindsight to reconstruct the invention and to indiscriminately combine the prior art. Accordingly, a person of ordinary skill in the art would not have been motivated to combine Nishizawa with Itoh, and withdrawal of this rejection is respectfully requested.

Claims 11, 21, 63 and 70 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishizawa et al. (U.S. Patent No. 5,275,184) (“Nishizawa”) in view of Mohindra et al. (U.S. Patent No. 5,958,146) (“Mohindra”). The rejection is respectfully traversed.

Mohindra discloses a cleaning technique for a semiconductor wafer that uses a hot or heated liquid in conjunction with a carrier gas which includes a cleaning enhancement substance. Mohindra discloses the use of control valves in the method of cleaning the semiconductor wafers, and the Office Action alleges that “it would have been obvious to one ordinary skill in the art . . . to have provided Nishizawa et al. reference with a valve as taught by Mohindra et al. because the use of valve would have provided another method of removing contaminants from the top of the wafer etching bath.” (Office Action at 9-10). However, the control valve in Mohindra is not used for the rapid removal of “surface contaminants from an air/liquid interface” of an upper portion of the etching fluid, as in the claimed invention. Rather, the control valve in Mohindra is used to allow a fluid to enter a filter bank, after the fluid was heated in a heater, and then into a wet processor. (Col. 5, lines 47-48; Col. 6, lines 29-35). Undoubtedly, the control valve in this reference merely “meters the carrier gas to the wet processor,” and not a processing fluid of an etching bath. Further, the control valve in Mohindra is not used to remove any portion of an etching fluid, and surely does not rapidly remove any surface contaminants, as it merely allows passage of a fluid from a filter bank into a processor. Once again, each reference is directed to solving different problems. Accordingly, there is nothing in the combination of Nishizawa and Mohindra, without the improper use of hindsight reconstruction, to motivate a person of ordinary skills in the art to arrive at the claimed method.

Claims 12, 15, 22, 25, 64, 67, 71 and 74 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishizawa et al. (U.S. Patent No. 5,275,184) (“Nishizawa”) in view of Hayami et al. (U.S. Patent No. 5,474,616) (“Hayami”). The rejection is respectfully traversed.

Hayami teaches a method for rinsing plate-shaped articles, such as semiconductor wafers, as well as cleaning equipment for the rinsing method. (Col. 2, lines 40-43). For this, Hayami uses a cleaning bath in which streams are directed upward from orifices of a feed pipe located near the bottom of the cleaning bath. (Col. 6, lines 1-4; Figures 41-42). The diameters of the orifices are adjusted “so that the jetting pressure of the cleaning water at all the orifices are uniform.” (Col. 6, lines 11-14). Hayami specifically notes that “it is necessary to stably maintain a state where a part of the surface of the cleaning water bulges so as to form uniform streams on the surface of the cleaning water.” (Col. 7, lines 13-16). Thus, while these uniform streams which are directed toward the rear and front walls are formed on the surface of the cleaning water, the semiconductor wafers are “gradually brought into the cleaning water.” (Col. 14, lines 40-45).

The claimed invention would not have been obvious over Nishizawa in view of Hayami. Indeed, the Office Action fails to establish a *prima facie* case of obviousness. First, both Nishizawa and Hayami are silent about the rapid removal of “surface contaminants” or of “contaminants from an air/liquid interface” by “hingedly releasing a door” or by “telescopically collapsing sidewalls of a vessel,” as independent claims 12, 15, 22, 25, 64, 67, 71 and 74 recite. Second, Hayami does not teach or disclose the *rapid* removal of surface contaminants from a *semiconductor processing fluid*, as independent claims 12, 15, 25, 64, 67, 71 and 74 recite. Hayami does not even teach or disclose a method for “etching a semiconductor wafer,” as independent claims 22 and 25 recite. Hayami refers only to water as the rinsing/cleaning liquid and the water in Hayami is not rapidly removed.

The references are also not combinable in view of the diverse areas involved in each reference. Nishizawa refers to wafer surface treatment by using at least two different solutions. Hayami, on the other hand, refers to the rinsing and cleaning of the wafers after the step of etching such wafers. It is clear, therefore, that the rejection is, once again, based on picking and choosing selected portions of each reference, in an attempt to improperly

use hindsight to reconstruct the invention. Accordingly, a person of ordinary skill in the art would not have been motivated to combine Nishizawa with Hayami and withdrawal of this rejection is respectfully requested.

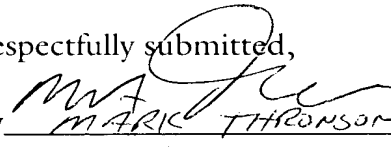
Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

By


MARIC THOMPSON #33,082

Thomas J. D'Amico

Registration No.: 28,371

DICKSTEIN SHAPIRO MORIN &
OSHINSKY LLP

2101 L Street NW

Washington, DC 20037-1526

(202) 828-2232

Attorney for Applicant

Version With Markings to Show Changes Made

61. (amended) A method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath for processing semiconductor wafers, said method comprising:

rapidly removing an upper portion of a semiconductor processing fluid present in said bath, while said wafers are in said bath, to permit flow of said upper portion of said processing fluid and thereby break eddy currents holding said surface contaminants at said air/liquid interface.

65. (amended) [The method for removing surface contaminants according to claim 61, wherein said upper portion of said semiconductor processing fluid is removed] A method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath for processing semiconductor wafers, said method comprising:

rapidly removing an upper portion of a semiconductor processing fluid present in said bath by sliding a door located at an upper portion of said bath, while said wafers are in said bath, to permit flow of said upper portion of said processing fluid and thereby break eddy currents holding said surface contaminants at said air/liquid interface.

66. (amended) [The method for removing surface contaminants according to claim 61, wherein said upper portion of said semiconductor processing fluid is removed] A method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath for processing semiconductor wafers, said method comprising:

rapidly removing an upper portion of a semiconductor processing fluid present in said bath by rapidly removing a wafer boat containing said wafers from said bath, while

said wafers are in said bath, to permit flow of said upper portion of said processing fluid and thereby break eddy currents holding said surface contaminants at said air/liquid interface.

68. (amended) A method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath for processing semiconductor wafers, said method comprising:

rapidly removing an upper portion of a semiconductor processing fluid present in said bath, while said wafers are in said bath, to permit flow of said upper portion of said processing fluid and thereby break surface tension forces holding said surface contaminants at said air/liquid interface.

72. (amended) [The method for removing surface contaminants according to claim 68, wherein said upper portion of said semiconductor processing fluid is removed] A method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath for processing semiconductor wafers, said method comprising:

rapidly removing an upper portion of a semiconductor processing fluid present in said bath by sliding a door located at an upper portion of said bath, while said wafers are in said bath, to permit flow of said upper portion of said processing fluid and thereby break surface tension forces holding said surface contaminants at said air/liquid interface.

73. (amended) [The method for removing surface contaminants according to claim 68, wherein said upper portion of said semiconductor processing fluid is removed] A method for removing surface contaminants from an air/liquid interface of a semiconductor processing bath for processing semiconductor wafers, said method comprising:

rapidly removing an upper portion of a semiconductor processing fluid present in said bath by rapidly removing a wafer boat containing said wafers from said bath, while

said wafers are in said bath, to permit flow of said upper portion of said processing fluid and thereby break surface tension forces holding said surface contaminants at said air/liquid interface.